Report on the Relationship Between Health Insurance Rates and Cancer Prevalence in the Greater Boston Area

Introduction

It is often assumed that having health insurance significantly influences health outcomes, such as cancer prevalence. However, research indicates that the impact varies across different types of health insurance, highlighting disparities in outcomes based on the specific coverage type.

"Care Without Coverage: Too Little, Too Late," published by the National Academies Press discusses studies that highlight the significant disparities in cancer care based on insurance status. Uninsured individuals were found to have delayed diagnoses and worse outcomes for various cancers, such as breast, cervical, and colorectal, which often lead to higher mortality rates. The studies also revealed that uninsured adults receive fewer cancer screenings, leading to diagnoses at later stages. Conversely, Private insurance patients typically had the best outcomes, while those with Medicaid had similar or sometimes worse outcomes than the uninsured[1].

The studies referenced in Care Without Coverage were conducted during the mid-1990s and early 2000s. Building on this foundation, this study examines the relationship between health insurance rates and cancer prevalence in the Greater Boston Area (GBA) for the years 2015 to 2019.

Massachusetts requires all residents 18 and older to have health insurance, with penalties for non-compliance or insufficient coverage. In the census tracts analyzed for this research, over 97% of the population is insured. As shown in Figure 1, health insurance coverage in Massachusetts varies significantly by income level. Families with higher incomes are more likely to have private health insurance, while lower-income households rely more on public programs like Medicaid. Despite these differences, employer-sponsored insurance remains the most common type of health insurance across all income levels.

As previous research has demonstrated, different health insurance types yield different outcomes, making it essential to examine these distinctions to better understand the results of this study. Health insurance in Massachusetts can be broadly categorized into public and private options, each with distinct characteristics and coverage plans.

Public insurance includes programs like Medicare, which provides coverage for individuals aged 65 or older, or those with specific disabilities or health conditions. Medicaid, a joint federal and state initiative, provides health coverage to low-income individuals and families, while VA Health Care offers health services specifically to U.S. veterans. On the private side, individuals can obtain insurance through direct-purchase plans. TRICARE offers coverage to U.S. military service members and their families, and Employer-sponsored insurance is the most common form of private coverage, providing benefits to employees and their families.

[1] https://www.ncbi.nlm.nih.gov/books/NBK220636/

Within employer-sponsored plans, Preferred Provider Organizations (PPOs) are the most prevalent. PPOs offer flexibility, allowing individuals to choose healthcare providers and specialists without needing referrals. However, certain services may require prior approval. Health Maintenance Organizations (HMOs), while representing 13% of covered workers, have become less common. These plans restrict coverage to in-network services and usually don't operate on a fee-for-service model. While HMOs offer lower deductibles and out-of-pocket costs for in-network care, the requirement for referrals can add extra costs. Point-of-Service (POS) plans, commonly found in the Northeast and among smaller firms, strike a balance between flexibility and cost, but may still be more expensive than HMOs due to referral requirements. Regarding out-of-pocket expenses, HMOs typically have the lowest costs, particularly for in-network care. POS plans come next, offering moderate out-of-pocket costs, especially if individuals go out-of-network, but with more flexibility. PPOs tend to have higher out-of-pocket costs, particularly for out-of-network services. High Deductible Health Plans (HDHPs) can result in the highest out-of-pocket expenses due to higher deductibles, although they generally come with lower premiums[2].

Medicare offers several options. Original Medicare consists of Part A (hospital insurance) and Part B (medical insurance), allowing recipients to use any doctor or hospital that accepts Medicare. Medicare Advantage (Part C), provided through private companies, covers Parts A, B, and often Part D (prescription coverage), offering additional benefits. The Program of All-Inclusive Care for the Elderly (PACE) combines medical, social, and long-term care services for frail older adults who can still live in the community. You can choose how you get your Medicare coverage when you first sign up or during certain times of the year. The decision you make affects how much you pay for coverage, what services you get, and what doctors you can use[3]. Based on potential out-of-pocket costs, ranking from lowest to highest would be: Original Medicare (lowest), Medicare Advantage (Part C), Part D, PACE (highest)[4].

In Massachusetts, Medicaid (MassHealth) offers several plans based on eligibility. Plans like the Accountable Care Partnership Plan and Primary Care ACO have the lowest out-of-pocket costs for members, while others like the Primary Care Clinician (PCC) Plan and Managed Care Organizations (MCO) may involve higher costs. Specific plans such as Standard and CommonHealth target people with disabilities, but generally come with higher out-of-pocket expenses. CarePlus is the most expensive plan, due to its limited coverage[5].

For private insurance, direct-purchase plans can include PPOs, HMOs, POS plans, and Consumer Driven Health Plans (CDHPs), which are typically PPOs with higher deductibles and lower premiums, providing individuals with more control over healthcare costs[6].

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[2] Common Types of Health Insurance Plans
[3] Understanding Medicare Advantage Plans
[4] Costs | Medicare
[5] MassHealth CarePlus Fact Sheet | Mass Legal Services
[6] Consumer-Directed Health Care: Will It Improve Health System Performance? - PMC).

Methodology

This study used two primary datasets. The first dataset is the CDC PLACES Dataset (2015–2019), which provides cancer prevalence estimates for U.S. census tracts. To analyze trends over time, data from five annual releases (2015-2019) were combined to calculate a five-year average cancer prevalence rate for each census tract in the Greater Boston Area.

The GBA was defined based on the cities included in the 2017–2019 CDC PLACES dataset and aligned with the Boston-Cambridge-Newton Metropolitan Statistical Area (BOS-CAM-NEW MSA). The study included cities that fell within this region, specifically Boston, Cambridge, Lawrence, Lowell, Lynn, Newton, Quincy, and Somerville. The data were subsetted to focus only on census tracts corresponding to these cities.

The second dataset utilized is the Census Bureau's Five-Year Health Insurance Estimates (2015–2019). This dataset contains detailed information on the types of health insurance coverage among individuals within each census tract, including Medicare, Medicaid, VA Health Care, TRICARE, direct-purchase plans, and employment-based insurance, as well as those without insurance. Health insurance rates for each type were determined by dividing the number of insured individuals with that type by the total population in each census tract.

To ensure consistency in the analysis, only data from individuals aged 19 and older were used, as the CDC cancer prevalence data is limited to adults. A five-year average for health insurance rates was also employed to account for any variations across the years.

The two datasets were merged by census tract, resulting in a final dataset of 350 tracts for analysis. A linear regression model was then applied to examine the relationship between health insurance types and cancer prevalence. Specifically, an Ordinary Least Squares (OLS) model was used, with the five-year average cancer prevalence rate for each census tract as the dependent variable. The independent variables included the rates of the six types of health insurance coverage: Medicare, Medicaid, VA Health Care, TRICARE, direct-purchase plans, and employment-based insurance.

The regression analysis aimed to assess the relationship between each type of health insurance and cancer prevalence and whether the relationship is statistically significant. Model diagnostics, including tests for normality and homoscedasticity of residuals, were conducted to ensure the validity of the findings.

Results

Figure 2 illustrates the trends in health insurance coverage between 2015 and 2019. Employer-based insurance saw a notable increase from 2015 to 2018, followed by a slight dip in

2019, before stabilizing. In contrast, direct purchase plans demonstrated a gradual upward trend, while government-funded programs like Medicare, Medicaid, TRICARE, and VA Health Care remained relatively steady, likely due to consistent funding and policy frameworks.

Figure 3 presents the cancer prevalence rates across the Greater Boston Area, with most areas reporting rates between 4 and 8, although a few outliers were observed.

In terms of health insurance coverage, Figure 4 reveals that employer-based insurance was the most common form of coverage in the Greater Boston Area during the period under study, followed by Medicaid.

The relationship between different types of insurance and cancer prevalence was examined through a linear analysis. The scatter plots show a weak correlation between employer-based insurance, Medicaid, TRICARE, VA Health Care, and uninsured rates with the five-year average cancer prevalence rate (Figures 5, 7, 9, 10 and 11). However, direct purchase plans exhibited a negative linear correlation (-0.4) with cancer prevalence, while Medicare displayed a relatively strong positive linear correlation (0.53) with cancer prevalence, as shown in Figures 6 and 8.

The OLS model

The normality and homeoskadicitiy assumptions required for the OLS model were met as shown by figures 12 and 13.

The results from this OLS regression model examine the relationship between cancer prevalence rates and various insurance rates. The adjusted R-squared of 0.422 indicates that approximately 42.2% of the variance in cancer prevalence is explained by the model's independent variables, which include Employer-based insurance rate, Direct purchase insurance rate, TRICARE rate, Medicare rate, Medicaid rate, and VA Healthcare rate.

Looking at the coefficients, the Medicare Rate has a statistically significant positive relationship with cancer prevalence (coefficient = 28.76, p-value < 0.00001), meaning that as the Medicare rate increases, cancer prevalence tends to increase. The Direct Purchase Rate shows a statistically significant negative relationship (coefficient = -7.01, p-value = 0.008), indicating that as the rate of direct purchase insurance increases, cancer prevalence decreases. Employer-based Rate and TRICARE Rate have p-values close to 0.05 (0.070 and 0.262, respectively), suggesting that their effects are less certain, with the Employer-based Rate showing a weak positive relationship and TRICARE showing no significant effect. Medicaid Rate and VA Healthcare Rate have non-significant p-values (0.623 and 0.962), implying that these insurance types do not have a significant impact on cancer prevalence in this model.

However, the F statistics of 43.15 shows that the combination of the different insurance rates (Employer-based, Direct Purchase, TRICARE, Medicare, Medicaid, and VA Healthcare) as predictors is significantly better at explaining cancer prevalence than a model with no predictors at all, and the model as a whole is meaningful in explaining cancer prevalence.

Discussion

The varying predictive power of different health insurance types on cancer prevalence rates in this study highlights the complex role that insurance coverage plays in health outcomes. Notably, certain insurance types, such as Medicare, showed a stronger correlation with cancer prevalence, while others, like employer-based insurance, Medicaid, TRICARE, and VA Health Care, demonstrated weaker associations.

The relatively strong positive correlation between Medicare coverage and cancer prevalence can likely be attributed to the demographic characteristics of Medicare beneficiaries. Medicare primarily serves individuals aged 65 and older, a population that experiences higher cancer rates due to age-related factors. As people age, they are more likely to develop cancer, making the positive relationship between Medicare coverage and cancer prevalence more predictable. Additionally, Medicare beneficiaries may have more access to regular screenings and treatments, which could contribute to the identification of cancers at earlier stages, thus increasing prevalence rates.

Employer-based insurance, while the most common form of coverage, does not necessarily correlate strongly with cancer outcomes because it is widespread across various age groups and health conditions. Employer-sponsored insurance does not target high-risk populations in the same way that Medicare does, and its widespread nature across diverse age ranges and employment statuses may lead to a diluted correlation with cancer rates. The heterogeneity within the employer-based insurance group, with varying access to care depending on plan type and employer offerings, further complicates any clear predictive relationship with cancer prevalence.

Similarly, government-funded programs like Medicaid, TRICARE, and VA Health Care serve populations with varying health needs. Medicaid primarily covers low-income individuals, and while it plays a crucial role in providing healthcare access, the populations covered by Medicaid often face additional barriers to healthcare, such as socioeconomic disparities, lower-quality care, and delays in diagnosis. These factors could influence cancer outcomes in ways that do not correlate directly with the type of insurance coverage. Furthermore, Medicaid recipients are often younger adults and children who are less likely to experience cancer than older adults, which could explain the weaker correlation between Medicaid and cancer prevalence in this study.

TRICARE and VA Health Care, which cater to military personnel and veterans, respectively, also exhibit weak correlations with cancer prevalence. While these groups may have specialized care access, factors such as the specific types of health conditions prevalent within these populations, including those related to military service, may not directly correspond to cancer prevalence. The correlation could be further diluted by differences in healthcare access, regional disparities, and the varied health needs of these populations.

In contrast, direct purchase plans showed a negative linear correlation with cancer prevalence. This suggests that individuals opting for direct-purchase insurance, which often involves higher premiums and fewer subsidies, may have a different demographic or health profile that impacts cancer rates. These individuals might be more health-conscious or have better access to early detection and preventive care, which could potentially reduce the prevalence of cancer

diagnoses. Additionally, the financial burden of direct-purchase insurance may limit the ability of certain individuals to seek healthcare, which could result in lower reported cancer prevalence rates due to delayed diagnoses.

In summary, the differences in predictive power among insurance types in this study highlight the importance of considering the demographics, quality of the insurance, other healthcare accesses, and specific needs of the populations covered by each insurance type. Medicare's stronger correlation with cancer prevalence is understandable due to the older age of its beneficiaries, who are at higher risk for cancer and have better access to screenings. Conversely, the weaker correlations observed for employer-based insurance, Medicaid, TRICARE, and VA Health Care suggest that insurance type alone may not be a sufficient predictor of cancer outcomes, and other factors, such as age, and the quality of the insurance plan, likely play a more significant role in influencing cancer prevalence.

Appendix

Distribution of Health Insurance type by Family Income

Family Income	Coverage Type							
	Private	Public	Insured	Uninsured	Employer	Individual	Medicaid/CHIP	Medicare
	%	%	%	%	%	%	%	%
Under $25,000	32.4%	62.1%	94.5%	5.5%	26.2%	6.2%	35.3%	26.7%
$25,000 - $49,999	47.5%	47.5%	94.9%	5.1%	41.0%	6.5%	24.9%	22.5%
$50,000 - $74,999	62.1%	34.6%	96.8%	3.2%	56.6%	5.6%	14.7%	19.9%
$75,000 or more	83.5%	15.4%	98.9%	1.1%	79.0%	4.6%	3.3%	12.1%

Figure1

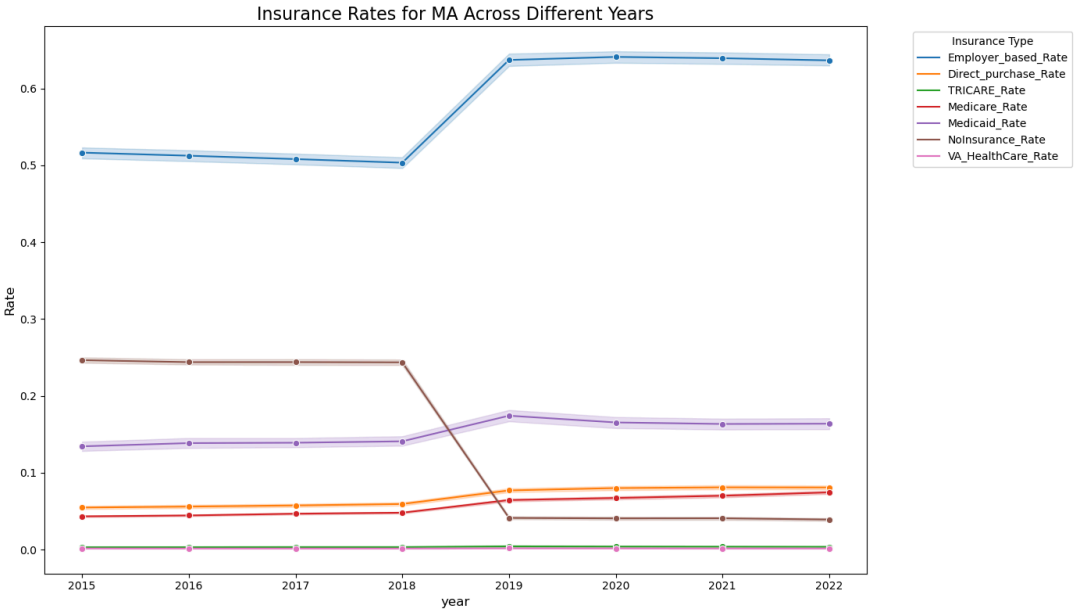
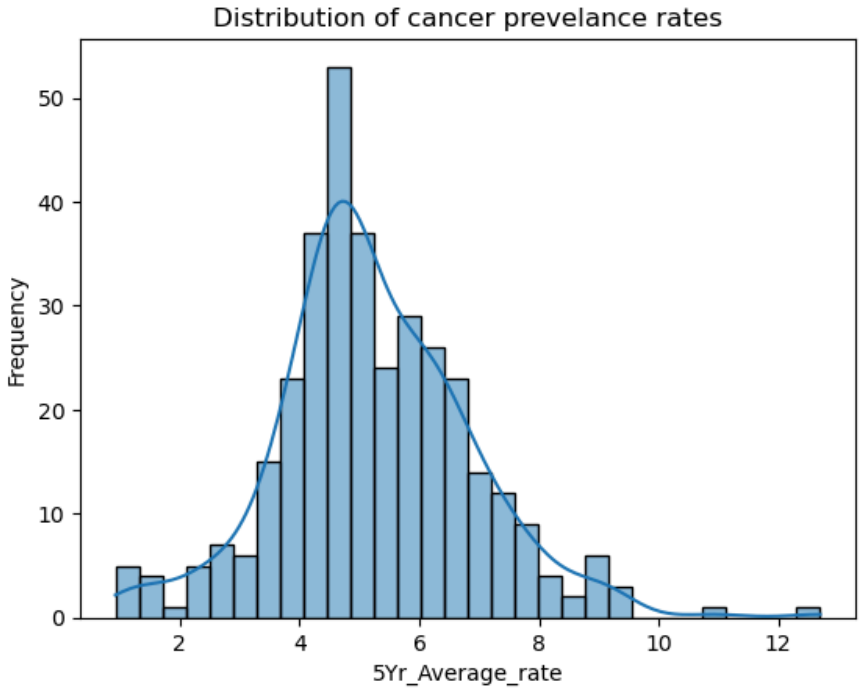


Figure2



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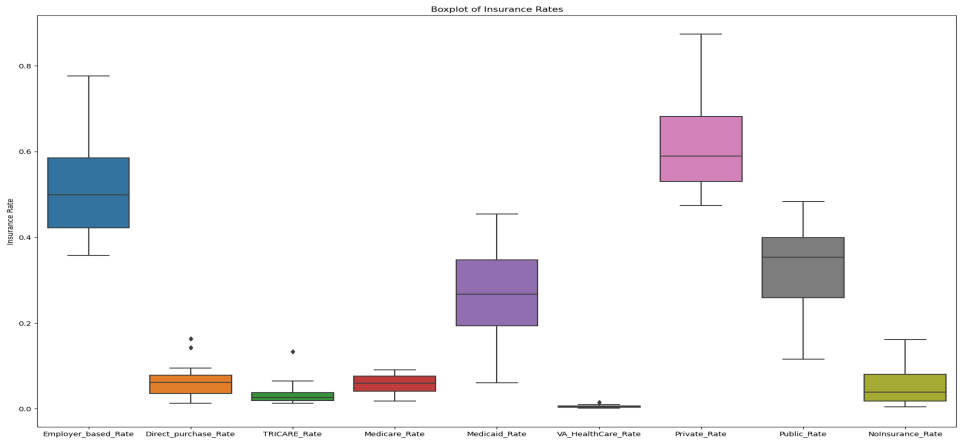
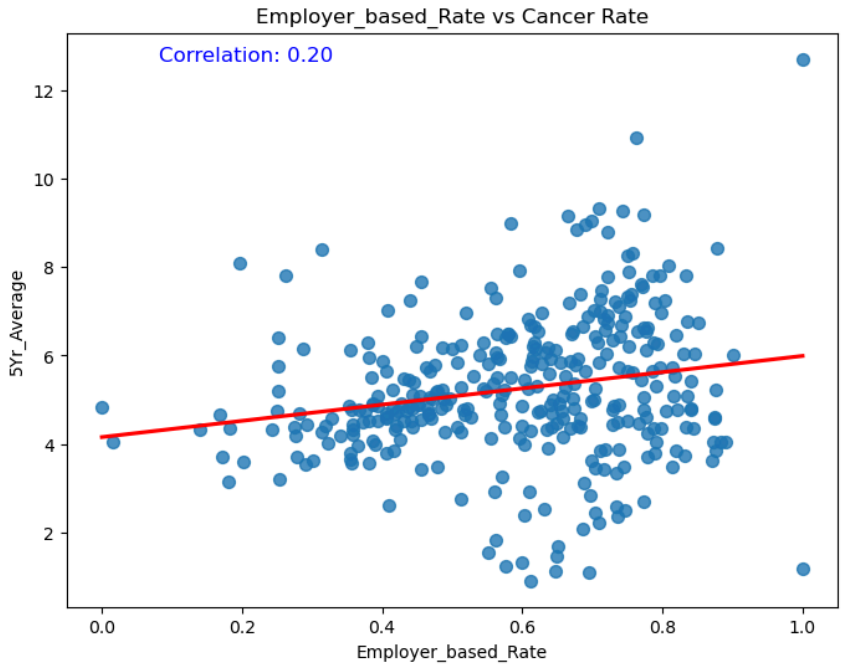


Figure4:

How do insurance types relate to the cancer rate in a linear fashion?



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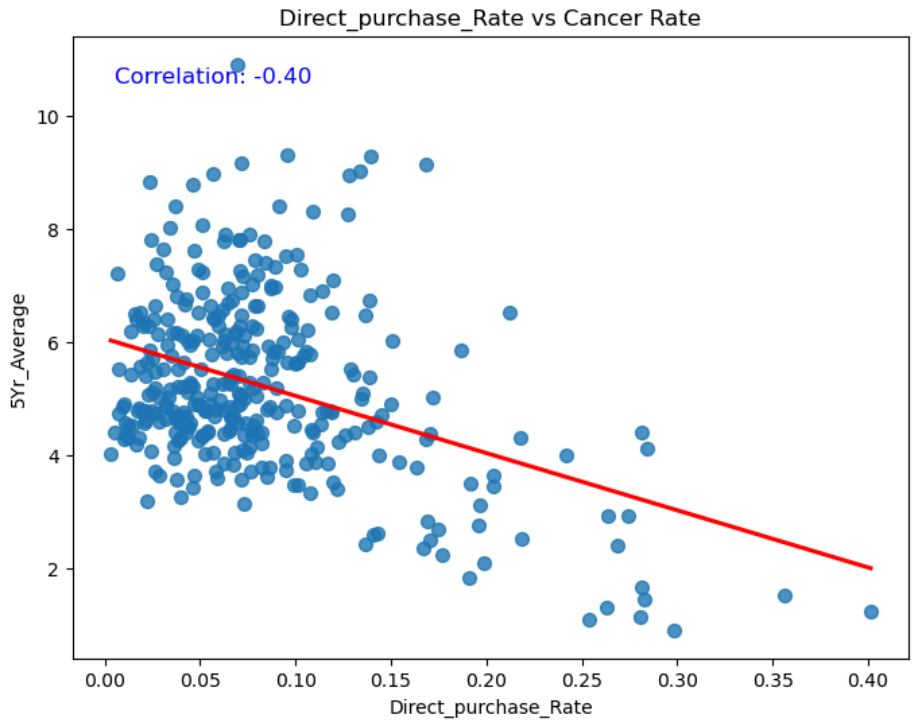

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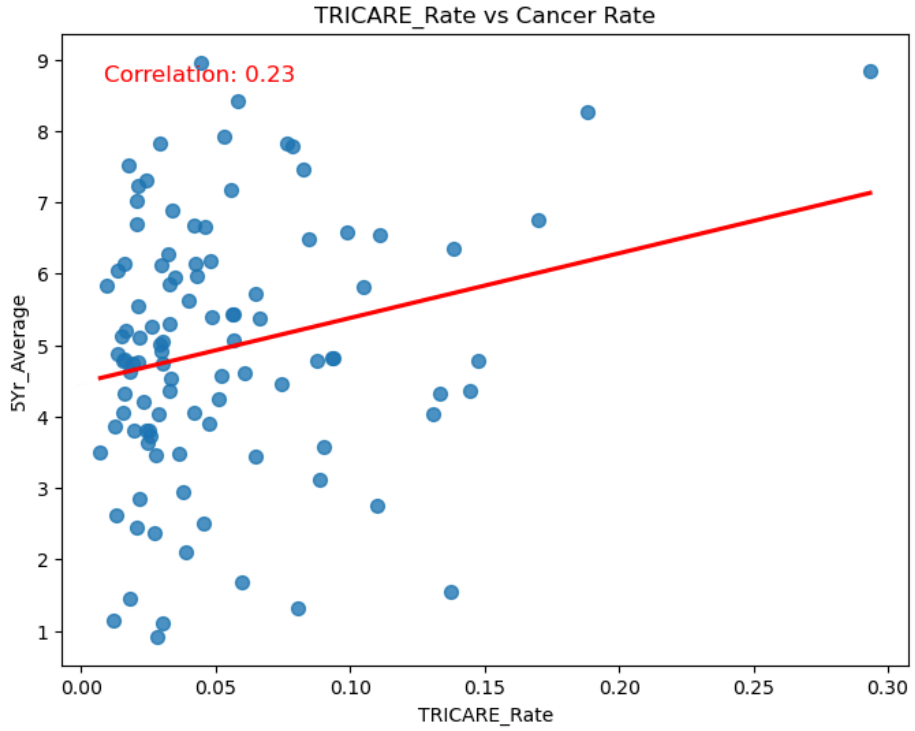

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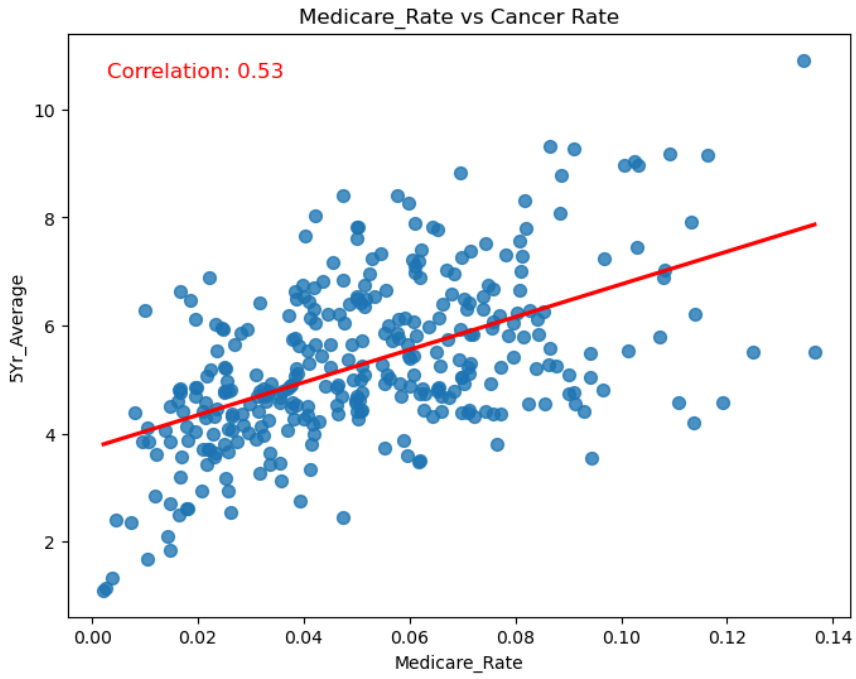
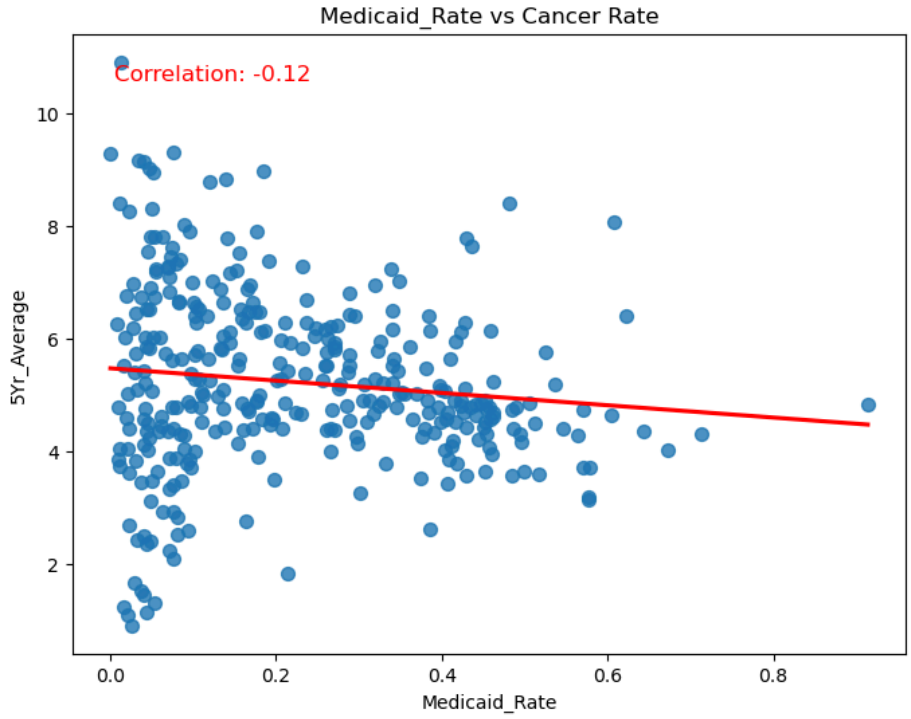


Figure8



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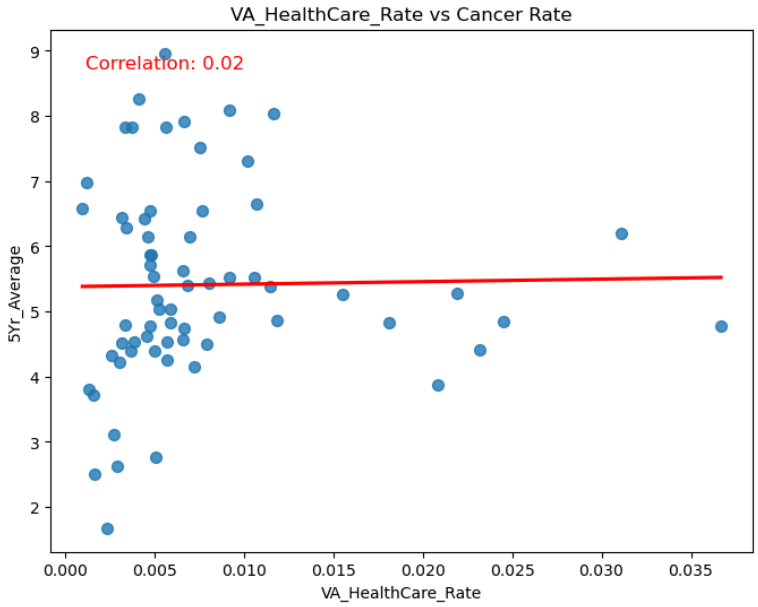

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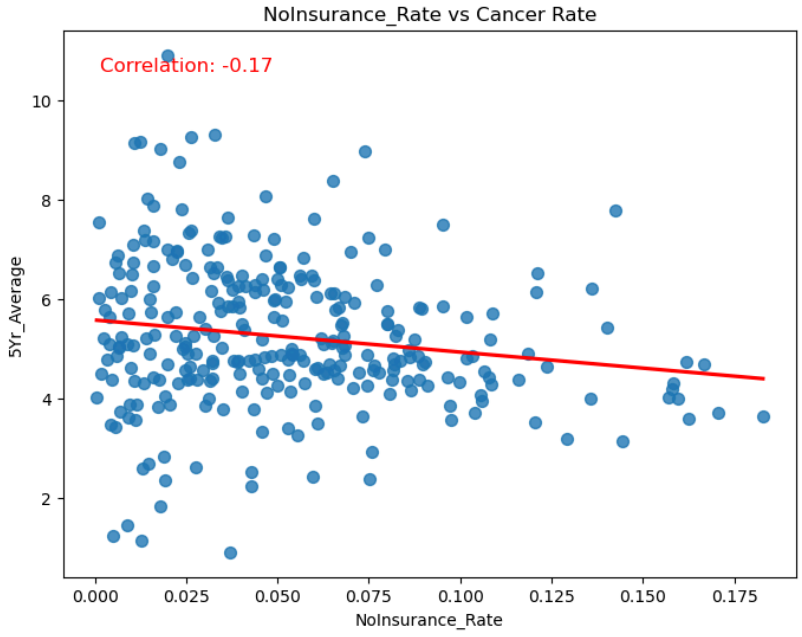

Figure11

The regression model results

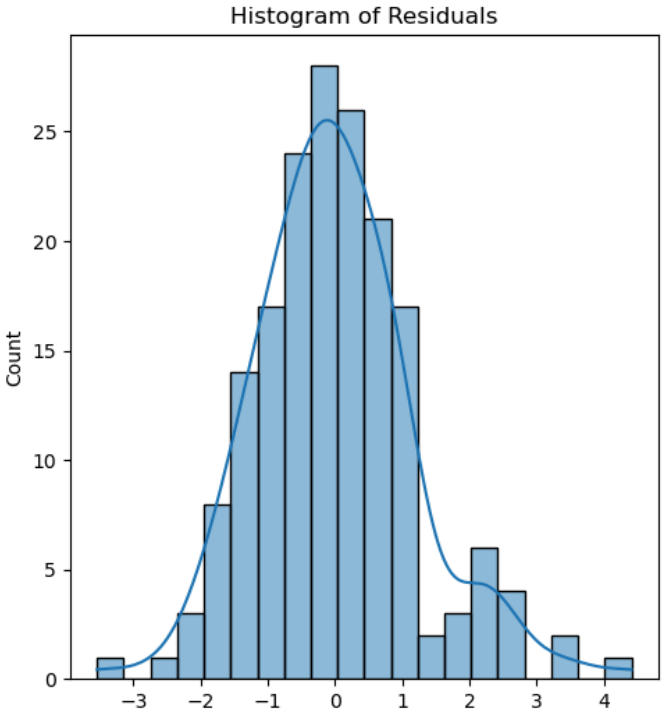

Figure12

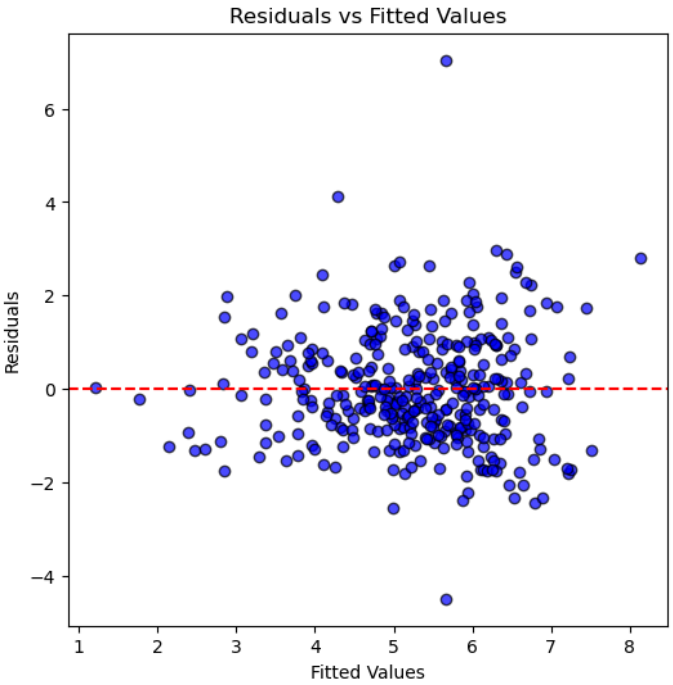

Figure13

Citation

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